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The Endogeneity of Optimum Currency Areas Criteria: Some Evidence from the European Union and Portugal

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Abstract Observing the statistical relationship between business cycles correlation and trade intensity in the European Union, euro zone, and the Portuguese economy, we conclude that there is, in general, a positive effect that supports the endogeneity argument proposed by Frankel and Rose (*The Economic Journal 108*(449):pp. 1009–1025, 1998). However, if we analyse this relationship in sub-periods – 1967–1975, 1976–1985, 1986–1992, and 1993–2003 – we conclude that endogeneity hypothesis just hold in the first two, although the correlations are increasing. This could mean that, after the Single European Act in 1986, other forces beyond trade are contributing to business cycle synchronization. The Portuguese business cycle correlation with the European Union and the Euro zone had also increased in these four decades, despite the fact that endogeneity hypothesis is at a 90 percent confidence level. We also analyse the bilateral relationships between the Portuguese economy and the other European Union countries and find that the endogeneity is confirmed in just four cases: Spain, Ireland, Netherlands, and UK.

Keywords economic and monetary union (EMU) · business cycles correlation · optimum currency areas · international trade

JEL Classification E32 · E42

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Table 1 Average business cycles correlation

	1967–1975	1976–1985	1986–1992	1993–2003	Whole Sample (1967–2003)
European Union	0.38	0.4	0.47	0.6	0.47
Euro zone	0.4	0.54	0.63	0.56	0.53

Introduction

Six years have passed since the beginning of the third phase of Economic and Monetary Union (EMU) in Europe with the official introduction of a common currency. For that reason it is still very early to completely evaluate all its implications. Moreover, the new currency was only physical introduced in 2002 and some of its consequences may present some delay. So, all the conclusions eventually obtained now face serious risks of incompleteness and precocity but are always interesting to observe. All these precautions should be retained for this analysis which results must be considered just a small contribute to the wide evaluation of the EMU effects in European economy.

This develops the previous works presented in Silvestre (2004) and Silvestre and Mendonça (2005) and the main objective of this work is to perceive if the countries that share the European common currency are moving to an Optimum Currency Area[1] or, instead, even with all the efforts, are walking in the opposite direction. This question is intimately related to the endogeneity of the optimum currency area criteria hypothesis proposed by Frankel and Rose (1996) in a paper published by the National Bureau of Economic Research (NBER).[2] The authors argue that a rise in trade intensity between countries should lead to a wider correlation of their business cycles. If this holds true, the countries will have, therefore, lower needs of autonomous monetary and exchange rate policies and opens the possibility that optimum currency area criteria could be verified ex-post even if they were not gathered ex-ante. Our intention is, precisely, to estimate this relationship in European Union, euro zone and evaluate, also, the particular case of Portuguese economy to understand if these countries follow a Krugman-type specialization (inter-industry) or an intra-industry specialization.

The text is organized as follows. The first section introduces the endogeneity hypothesis proposed by Frankel and Rose. The next section reviews some empirical results about European business cycles and the endogeneity hypothesis. Then the paper presents the econometric model and the results for European Union and euro zone. The final section analyzes the Portuguese case.

[1] Optimum currency area concept was introduced by Mundell (1961) in a very famous paper. For a revision of the main theoretical support see, for instance, De Grauwe (2003) or Mongelli (2002).

[2] The reference presented in this paper dates back to 1998 because we are considering the publication of the article in The Economic Journal. However, Frankel and Rose first published the text in 1996 as a NBER paper.

Table 2 Portuguese average correlation with European Union and Euro zone

	1967–1985	1986–2003	Whole Sample (1967–2003)
European Union	0.44	0.68	0.56
Euro zone	0.54	0.73	0.64

The Endogeneity of Optimum Currency Area Criteria Hypothesis

Many authors argued that the creation of a monetary union could lead the involved countries to an optimum currency area. This argument was first introduced by Frankel and Rose (1998) and has been broadly discussed since then. These authors argue that an increase in trade integration can lead to tighter business cycles correlation and, consequently, to a smaller need of monetary independence. This conclusion is the opposite of inter-industry specialization process defended by Paul Krugman (1993). With this paper Frankel and Rose opened a wide debate about optimum currency areas, arguing that the introduction of a common currency in a region can help to meet criteria ex-post even if they are not verified ex-ante. They analyze the business cycles and trade intensities of 20 industrialized countries, between 1959 and 1993, and find a positive statistical relationship between these two criteria. At the end, they say it is just an application of the famous "Lucas Critique" (Lucas, 1976) to the analysis of optimum currency areas, arguing that business cycles correlation is endogenous regarding trade between States because both are affected by policies. Intuitively, this means that business cycles of the countries belonging to a monetary union are affected, after the integration, by a centralized monetary policy but also by an increase their trade flows.

This relationship between trade intensity and business cycles correlation, in a theoretical point of view, is able to assume positive or negative signs. If there is an inter-industry specialization based on comparative advantages, as defended by authors like Paul Krugman (1993) or Kenen (1969), then cycles tend to be less symmetrical and the coefficient should be negative. In the opposite way, if the specialization process is mainly intra-industry, i.e., the bulk of the trade flows are within the same sector, cycles will be more correlated and the coefficient is positive.

Table 3 OLS estimates for European Union (1967–2003)

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.0850874 (0.000)	0.0476827 (0.005)	0.0740333 (0.000)
R^2	0.0510	0.0212	0.0387

p values in parenthesis.
N=364

Table 4 OLS estimates for period 1967–1976

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.1265383 (0.000)	0.708753 (0.006)	0.1117887 (0.000)
R^2	0.2145	0.0827	0.1573

p values in parenthesis.
N=91

This is the vision of the European Commission (1992) that gave theoretical support to the Economic and Monetary Union project in the Europe.

Despite the obvious influence of specialization pattern in business cycles correlation there are, in fact, many other factors playing an important role in idiosyncratic shocks transmission across monetary union members. An increase in public expenditure or private investment in a specific country has consequences not only in the domestic economy but also in the economies with higher rankings of economic integration. The eventual benefit taken from business cycle correlation as result of an increase in trade intensity is still reinforced by the fact the participation in a monetary union is also a catalyst for trade between members. This is known as the "Rose Effect" (Rose, 2000) because this author was the first to estimate it. Since Rose, many other empirical studies showed a positive relationship between the share of a common currency and trade flows. The estimates ranged between very low values and 376 percent.[3]

Previous Empirical Results

Business cycles correlation has been empirically tested several times. Being considered the two main criteria to evaluate ex-ante the monetary integration success had motivated many works with different methodologies and data samples. One of the most used methods to measure business cycles symmetry is the VAR methodology developed by Blanchard and Quah (1989). With the VAR model, Bayoumi and Eichengreen (1993) concluded that the European shock asymmetry was larger than in the US and, because of that, the adoption of a common currency would be a risk. De Grauwe and Vanhaverbeke (1991) concluded that the idiosyncratic shocks tend to be more persistent between regions inside same country than between European countries.

Artis and Zhang (1997) found a common cycle in Europe as predicted by the endogeneity hypothesis. Kenen (2000) argued, however, that business cycles correlation can happen in consequence of the trade integration but that does not

[3] Rose (2004) provides an extensive review of these results.

Table 5 OLS estimates for period 1977–1985

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.1470666 (0.001)	0.0663801 (0.075)	0.1145407 (0.006)
R^2	0.1267	0.0352	0.0814

p values in parenthesis.
N=91

means that shocks symmetry itself has to decrease. According to the author, the monetary unions affect the shock transmission mechanism but not its incidence. Related to this argument, Hughes Hallet, and Piscitelli (1999) showed that a monetary union can accelerate the cycles convergence but only when a sufficient symmetry in the monetary transmission exists, namely through prices and salaries. Fridmuc (2001) tested the endogeneity hypothesis with a regression similar to the originally proposed by Frankel and Rose but including a structural variable-intra-industry trade – and concluded that there is a positive relationship between this variable and business cycles correlation. So, because intra-industry trade is positively related to bilateral trade intensity, the endogeneity hypothesis holds. But the estimates pointed to a Krugman-type specialization process.

Corsetti and Pesenti (2002) show, theoretically, that a monetary union could become optimum ex-post even without an intra-industry specialization process. According to these two authors, this situation occurs as a result of the authorities' commitment and agents reaction, in price setting, that transforms the fixed exchange rates optimal in a self-validating way. More recently, Artis (2003) concluded that cannot be found a European business cycle and, although some countries present large synchronizations, others are nearer to the US or Japanese economies due to globalization. Babetski (2004) studied Enlargement countries and verified that trade integration leads, in general, to a wider symmetry of the demand shocks but, in supply shocks, it depends on the country considered. He concluded also that a reduction exchange rate volatility have a positive effect in demand shocks convergence and, at least in what concerns to these shocks, confirms the endogeneity hypothesis.

Table 6 OLS estimates for period 1986–1992

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.001498 (0.975)	−0.0182104 (0.668)	−0.0046582 (0.922)
R^2	0.0000	0.0021	0.0001

p values in parenthesis.
N=91

Table 7 OLS estimates for period 1993–2003

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.0047058 (0.9000)	0.276749 (0.367)	0.0166908 (0.383)
R^2	0.0002	0.0092	0.0023

p values in parenthesis.
N=91

Econometric Model

Now, we are going to evaluate the relationship between the cycles symmetry and trade intensity in European Union. Obviously, many other factors beyond bilateral trade intensity play a role in cycles' synchronization and in shock incidence or transmission, but the objective of this analysis is only to evaluate the trade effect and not trying to find all the explanatory variables of business cycles correlation. In fact, though the statistical significance of the model, it has reduced explanatory power and R^2 of the regressions are very low.

The econometric analysis is based on GDP and bilateral imports/exports annual data collected from Chelem Database for 14 countries of the European Union[4] in the period 1967–2003. The model follows the originally proposed by Frankel and Rose:

$$Corr\left(Q_i, Q_j\right) = \alpha + \beta ln\left(IC_{ij}\right) + \upsilon_{ij}$$

i.e., business cycles correlation (Corr(Q_i, Q_j)) – is used the annual GDP between 1967 and 2003 – is explained as a function of the natural logarithm of bilateral trade intensity (ln(IC_{ij})). The trade intensity is defined in three distinct forms: exports, imports, and total trade. υ_{ij} is a random error term.

Business cycles correlation is measured by bilateral correlation coefficient of economic activity cycles obtained from the GDP statistics with Hodrick–Prescott[5] filter. For trade intensities we considered the following three ratios:

$$Exports \quad TIx_{ijt} = \frac{X_{ijt}}{X_{it} + X_{jt}}$$

[4] Chelem Database has aggregate trade statistics to Belgium and Luxembourg.

[5] Hodrick and Prescott (1980). Filters are used, and H–P is only the most common between several others, to extract the cyclical component from the series. This it is obtained solving the following minimization problem in order to x_t^*:

$$\underset{x_t^*}{Min} \sum_{t=1}^{T} \left(x_t - x_t^*\right)^2 + \lambda \sum_{t=1}^{T} \left(\left(x_{t+1}^* - x_t^*\right) - \left(x_t^* - x_{t-1}^*\right)\right)^2$$

Table 8 OLS estimates for Euro zone (1967–2003)

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.0909179 (0.000)	0.0590074 (0.002)	0.0832918 (0.000)
R^2	0.0775	0.0419	0.0648

p values in parenthesis.
N=220

$$Imports \quad TIm_{ijt} = \frac{M_{ijt}}{M_{it} + M_{jt}}$$

$$Total\ Trade \quad TIt_{ijt} = \frac{X_{ijt} + M_{ijt}}{X_{it} + X_{jt} + M_{it} + M_{jt}}$$

TIx_{ijt} is bilateral trade intensity between the country i and the country j in moment t measured by exports. TIm_{ijt} and TIt_{ijt} represent trade intensity measured by imports and total trade. X_{it}, X_{jt}, M_{it} and M_{jt} are, respectively, the total exports of the countries i and j at moment t and the total imports of the countries i and j at moment t. X_{ijt} and M_{ijt} are the exports from country i to country j and the imports from country j to country i at moment t.

To estimate the equation, sample was splat in four sub-samples: 1967–1977, 1977–1985, 1986–1992, and 1993–2003. Trade intensity was calculated for each one of the four periods from the annual data and we obtain four values for each pair of countries (12 if we consider exports, imports, and total trade).

For the GDP data, we extracted the cycle from the series [in logarithms] using the Hodrick–Prescott filter with λ=100, as usual for annual data, and calculated bilateral correlation coefficient in the four sub-periods. Due to endogeneity,[6] namely the fact that trade is also dependent on monetary arrangements, we use ordinary least squares (OLS) but also instrumental variables estimation (two-stages least squares (2SLS)). In the latter, trade intensity was estimated with a gravity model and the regressions were carried out with these fitted values. For the gravity equation,[7] we consider three explanatory variables that are very usual in this kind of models: distance (in logarithm), the existence of a common border and the share of a common language. The last two variables are dummy variables that assume value 1 when the condition is verified – border or common language – and 0 when these conditions are not verified. We conclude, however, that in certain cases some of these dummy variables were not statistically significant and, in those situations, we take them out of the model.

The estimates confirm a positive relationship between bilateral trade intensity and business cycles correlation in European countries. All the equations were estimated

[6] Exogenous variables are correlated with a random error term.

[7] Rose (2000) presents a revision of gravity models literature.

Table 9 OLS estimates for period 1967–1976

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.1515852 (0.000)	0.1101421 (0.001)	0.1472965 (0.000)
R^2	0.3296	0.2020	0.2903

p values in parenthesis.
N=55

for the 15 countries of the European Union, and also for the 12 participating in EMU.[8] In general, independently of the trade indicator used to compute bilateral trade intensity – exports, imports, or total trade – the results confirm the Frankel and Rose argument and suggest an intra-industry specialization profile. First, we present some descriptive statistics about business cycles correlation.

Descriptive Statistics

A brief look at the business cycles descriptive statistics immediately give the idea that, in European Union, economies are more synchronized now than four decades ago. Table 1 presents the average correlation in European Union and euro zone.

As we can see, business cycles correlation in European had increased progressively in this period, with coefficient growing from 0.38 in 1967–1975 to 0.6 in the last period. On the contrary, correlation in euro zone presented some oscillations. After an increase from 0.4 to 0.63 in the first two periods, the average business cycles correlation in euro zone moves back to 0.56 between 1993 and 2003. Many possible explanations could be proposed but this behaviour is probably related to some last minute efforts to accomplish the convergence criteria that take some business cycles out of their normal path. For Portugal, despite the lower sample dimension, we find that average business cycles correlation with European Union and euro zone grew rapidly in these four decades. The statistics are presented in Table 2.

Average correlation between Portuguese business cycle and euro zone economies business cycles increased from 0.54 to 0.73, while with European Union business cycles grew from 0.44 to 0.68. Is, therefore, a great advance in business cycles correlation that has a most dramatic evolution after the admission to European Community in 1986.

OLS Estimation for European Union

Table 3 compiles the OLS estimation results for European Union. The estimated coefficients confirm that exists, in fact, a positive relationship between the business cycles correlation and trade intensity in these 15 countries.[9] This result supports the

[8] The United Kingdom, Denmark, and Sweden are not in EMU. Euro zone: Portugal, Spain, France, Belgium, Luxembourg, Holland, Germany, Austria, Italy, Greece, Finland, and Ireland. As we said previously, the Chelem database presents aggregate statistics for Belgium and Luxemburg.
[9] We are considering the 15 European countries before the last enlargement.

Table 10 OLS estimates for period 1977–1985

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.1481579 (0.003)	0.0875327 (0.049)	0.1254134 (0.011)
R^2	0.1545	0.0712	0.116

p values in parenthesis.
N=55

endogeneity hypothesis presented by Frankel and Rose and suggests that business cycles are becoming more synchronized.

Looking at Table 3, we see that the estimated coefficients were 0.08, 0.04, and 0.07, respectively, for the trade intensity computed with the logarithms of the exports, imports, and total trade. In all cases, R^2 is very low, showing the limited explanatory power of the model and the absence of other determinant variables for business cycles correlation. That was not, however, the goal of this analysis that intended only to find the relationship between these two variables and to evaluate the endogeneity in euro zone and European Union.

The low R^2 obtained are probably related with the fact that, in certain sub-periods, bilateral trade intensity is not statistically significant to explain the business cycles correlation. Doing the same regression for each one of the four sub-samples, we find that, in fact, only in periods 1967–1976 and 1977–1985 is possible to consider trade intensity as a determinant factor of economic synchronization. On the contrary, in periods 1986–1992 and 1993–2003, trade intensity is not statistically relevant considering the *t*-tests. Tables 4, 5, 6 and 7 presents the results of these four regressions.

These results show a higher R^2 in the first two periods than the obtained for whole sample and for the two last periods. Since 1986, trade intensity does not seem to have any influence in business cycles correlation. This situation must be related with other different forces of cycles' synchronization, like Single European Act, Maastricht Treaty, and convergence criteria, among others. Probably, trade intensity is a very important factor of business cycles correlation just when there

Table 11 OLS estimates for period 1986–1992

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.001206 (0.998)	−0.0276476 (0.486)	−0.127439 (0.773)
R^2	0.0000	0.0092	0.0016

p values in parenthesis.
N=55

Table 12 OLS estimates for period 1993–2003

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.0069674 (0.881)	0.0121927 (0.754)	0.0114622 (0.806)
R^2	0.0004	0.0019	0.0011

p values in parenthesis.
N=55

are not other factors of interdependence and countries pursue totally independent economic policies.

OLS Estimation for Euro Zone

For the 12 countries of euro zone the results go in the same direction. Table 8 reports the results. The estimated βs were 0.09, 0.06 and 0.08, respectively, for the exports, imports, and total trade.

Like in the European Union case, trade intensity is not statistically significant as explanatory variable of the business cycles correlation in euro zone since 1986. In Tables 9, 10, 11 and 12, the results are presented for each one of the four sub-periods. Once again, the R^2 in periods 1967–1976 and 1977–1985 are above of the obtained for the complete sample.

Instrumental Variables Estimation (2SLS)

Due to endogeneity between trade intensity and the error term, the same equation was estimated using instrumental variables.[10] As we said previously, we used three variables – common border, common language, and logarithm of the distance – to estimate bilateral trade intensities. In some cases, one of these variables were not statistical significant and we take them out the model.

Table 13 presents the results with instrumental variables for the 15 countries of the European Union. Like OLS estimates presented earlier, these confirm the existence of a positive relationship between trade intensity and business cycles correlation. Estimated coefficients were 0.09, 0.07, and 0.08, respectively, for exports, imports and total trade.

Table 14 shows the results of 2SLS estimation for euro zone. The estimated βs validate the endogeneity hypothesis and suggest an intra-industry specialization process that is contributing to business cycles correlation.

[10] We make Hausman tests that confirmed the endogeneity hypothesis and suggested the use of 2SLS estimation.

Table 13 2SLS estimates for European Union (1967–2003)

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.0859178 (0.002)	0.0687854 (0.003)	0.0795043 (0.002)

p values in parenthesis.
N=364

For euro zone countries, estimated coefficients are above the results obtained for the European Union, with values of 0.09, 0.07, and 0.08, respectively, exports, imports, and total trade. We do not present R^2 because with 2SLS estimation they are not valid.

Dividing the sample in the four sub-periods considered, we confirm the conclusions of OLS estimation. As we can see in Tables 15, 16, 17 and 18 for European Union and euro zone, based on *t*-statistic, the estimated coefficients are only statistically significant in the two first periods.

The Portuguese Case

The application of the same model to the Portuguese economy did not produce very satisfactory results. For the majority, the estimates are not statistically significant at 95 percent confidence level, and only if we consider a 90 percent confidence level, is it possible to obtain significant estimates and, in those cases, the endogeneity hypothesis is validated. However, this situation could be related with the fact that Portuguese trade relations differ among European Union Members. To evaluate this question, we carried bilateral regressions which results are presented in the end of this section.

Table 19 represents the OLS results for Portugal with the 15 countries of European Union before the last Enlargement. Estimated coefficients were 0.1, −0.01, and 0.07, respectively, for the exports, imports, and total trade. The estimated β for trade intensity measured from the imports assumes a negative value but is not, however, statistically significant. The coefficients of trade intensity based in exports and total trade are statistically significant only if we consider a 90 percent confidence level.

Table 14 2SLS estimates for Euro zone (1967–2003)

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.0898417 (0.003)	0.0718043 (0.004)	0.0791956 (0.004)

p values in parenthesis.
N=220

Table 15 2SLS estimates for period 1967–1976

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation (European Union)	0.115622 (0.004)	0.0994344 (0.008)	0.1105883 (0.005)
Business Cycles Correlation (Euro Zone)	0.112851 (0.012)	0.98615 (0.018)	0.1088313 (0.014)

p values in parenthesis.
N=91; *N* =55

The same happens when the endogeneity hypothesis is evaluated between Portugal and the other 11 countries of the EMU, as is represented in Table 20. In this situation, even with a 90 percent confidence level, only the regression that uses trade intensity computed from exports is statistically significant.

Using the estimation 2SLS, the conclusions are similar. Table 21 represents the estimates for Portugal and European Union that show that, even with a 90 percent confidence level, only the trade intensity calculated from exports and total trade are statistically significant.

If we consider only the euro zone, it is not possible to obtain statistically significant estimates with instrumental variables. As we can see in Table 22, the three estimates have *p* values over 5 and 10 percent.

The regressions carried out for the particular case of Portuguese economy validate the endogeneity hypothesis proposed by Frankel and Rose in some cases. This only happens with a confidence level of 90 percent. Using the most usual confidence level, 95 percent, none of the estimated coefficients for the Portuguese economy are statistically significant. This situation could be explained by low sample dimension. Like in the other regressions previously presented for European Union and the euro zone, trade intensity looks to have a low influence in business cycles correlation of Portuguese economy, though this relationship tends to be positive.

In order to evaluate the particular case of the Portuguese economy and its links to the other European economies, we also made bilateral estimates. We use the same Frankel–Rose model presented earlier, but consider five-year moving averages instead of static averages by period. With this methodology, we can have a larger sample (*N*=33), which was necessary to estimate these bilateral equations, but, at the same time, more dynamic variables. Otherwise, even with the four-period averages, we just have four observations for each pair of countries. Table 23 presents the estimates with total trade intensity in absolute values and in logs.[11]

[11] In this case, we cannot use instrumental variables estimation, unlike the estimates presented in the previous section, when we use common border, common language, and distance as instrumental variables.

Table 16 2SLS estimates for period 1977–1985

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation (European Union)	0.1583925 (0.005)	0.1338523 (0.008)	0.1479528 (0.006)
Business Cycles Correlation (Euro Zone)	0.1590668 (0.014)	0.1337221 (0.018)	0.1479682 (0.014)

p values in parenthesis.
N=91; *N*=55

In this bilateral estimation, we conclude that the endogeneity hypothesis between Portugal and the other 14 European countries is confirmed in four cases: Ireland, Netherlands, United Kingdom, and Spain. In these four regressions, the conclusions are the same with trade intensities in logs or in absolute values. The Spanish case is not surprising. The economic integration between Portugal and Spain is deeply consolidated and is normal to expect that trade links could explain, tough partially, the business cycles correlation. Spain is the main Portuguese trade partner and trade flows between the two countries increased very rapidly in the last two decades.

For the United Kingdom, the conclusions could be similar. Historically, the British economy is one of the most important destinations for Portuguese exports and, despite the evolution in the previous years, the United Kingdom is still an important trade partner.

The other two cases, Netherlands and Ireland, even with the endogeneity hypothesis confirmed, the trade flows probably are not sufficient to produce a significant impact on bilateral business cycles correlation. Nevertheless, if Portuguese trade links with this two-country increase in the future, we can expect a wider correlation.

We also introduce in the model two dummy variables (results not presented) for the monetary unification, corresponding to 1999, and for the Portuguese entrance in European Union in the beginning of 1986. We used these two variables to capture the eventual effects of these moments in the bilateral endogeneity hypothesis. In almost every estimate, the two dummies were not statistically significant. The

Table 17 2SLS estimates for period 1986–1992

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation (European Union)	0.0082661 (0.901)	0.0027394 (0.936)	0.0049801 (0.936)
Business Cycles Correlation (Euro Zone)	0.0321056 (0.533)	0.0280659 (0.57)	0.0311374 (0.576)

p values in parenthesis.
N=91; *N*=55

Table 18 2SLS estimates for period 1993–2003

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business cycles correlation (European Union)	0.0496527 (0.347)	0.0420904 (0.287)	0.0476901 (0.312)
Business Cycles Correlation (Euro Zone)	0.0429628 (0.511)	0.0355824 (0.466)	0.411581 (0.479)

p values in parenthesis.
N=91; *N*=55

exceptions were: for Germany, Netherlands, and Sweden, the 1986 date is significant; for Greece, the euro dummy is significant. These results, namely in the cases where the endogeneity hypothesis proposed by Frankel and Rose is not confirmed, could suggest that in some cases, the participation in European Union (after January 1986) and in the European Monetary Union (after January 1999) contributed for closer businesses cycles between Portugal and these countries.

Conclusions

Based on the econometric analysis presented, we conclude that trade intensity has a positive effect in business cycles correlation in European Union. A result that confirms endogeneity hypothesis defended by Frankel and Rose and the fact that trade flows are helping the European Union to move to an optimum currency area. These results also suggest that specialization process in Europe is mainly intra-industry type. Nevertheless, these results only support the endogeneity hypothesis if we consider the whole sample.

If we divide the sample in four sub-periods and make the same regressions OLS and 2SLS, we find a very interesting fact. In the two first periods, 1967–1975 and 1976–1985, trade intensity is statistically significant as an explanatory variable of the bilateral business cycles correlation and presents a R^2 above the obtained for the complete sample. On the contrary, in the two last sub-periods, 1986–1992 and 1993–

Table 19 OLS estimates for Portugal and European Union (1967–2003)

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.1054562 (0.079)	−0.0099266 (0.895)	0.0718277 (0.061)
R^2	0.0603	0.0399	0.0682

p values in parenthesis.
N=52

Table 20 OLS estimates for Portugal and Euro zone (1967–2003)

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.0930788 (0.053)	0.0647652 (0.361)	0.0387696 (0.237)
R^2	0.0951	0.022	0.0365

p values in parenthesis.
N=40

2003, the trade intensity is not statistically significant. This is true with any of the indicator used to measure the bilateral trade intensity – exports, imports, and total trade – and whether we consider the 15 countries of European Union or only the euro zone. These estimates for the sub-samples help to explain the reason why the regressions for the whole sample present very low R^2. Probably since 1986, other factors are explaining the business cycles correlation.

This empirical observation make some sense, intuitively, if we think that the political coordination and economic integration of last two decades had created many other factors of interdependence beyond trade. In the Portuguese economy, despite some not statistical significant estimates with a 95 percent confidence level, it is possible to obtain significant estimates with a 90 percent level that confirm the conclusions regarding the euro zone and European Union.

Evaluating the bilateral trade relations between Portugal and the other countries case, we find evidence of the endogeneity hypothesis in four estimates: Spain, Netherlands, Ireland, and the United Kingdom. Probably, it is necessary to have sufficient large trade flows to ensure that trade intensities have influence on business cycles correlation. These results were obtained with the same model proposed by Frankel and Rose but using 5-year moving averages for business cycles correlation and trade intensities.

We use also two dummy variables – for euro (1999) and for Portuguese entrance (1986) – to assess if these two moments had any impact on business cycles correlation. Only for Germany, Netherlands, and Sweden the 1986 dummy was statistical significant, and the Greece euro dummy was statistical significant.

The verification of endogeneity hypothesis, as suggested by Frankel and Rose, in the cases presented in this paper, does not necessary means that others important

Table 21 2SLS estimates for Portugal and European Union (1967–2003)

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.1421704 (0.066)	0.3187752 (0.126)	0.0791956 (0.004)

p values in parenthesis.
N=52

Table 22 2SLS estimates for Portugal and Euro zone (1967–2003)

	Trade Intensity		
	Log Exports	Log Imports	Log Total Trade
Business Cycles Correlation	0.0893422 (0.128)	0.1714856 (0.158)	0.1131918 (0.166)

p values in parenthesis.
N=40

explaining factors of business cycles correlation must me neglected. Mainly because in the four sub-periods estimates endogeneity hypothesis is not verified in last two (since 1986). This permits to conclude that since that date – that corresponds to the year of Single European Act – other factors are deciding business cycles synchronization in European Union. Probably, it is the result of economic integration efforts and policy coordination in these two decades. For Portugal, we obtain a very predictable conclusion. The business cycles correlation with Spain, the Portuguese main trading partner, is influenced by trade flows.

Table 23 Bilateral estimates for Portugal

	Total trade Intensity (Logs)	Total trade Intensity (Absolute Value)
France	0.03022886 (0.864)	5.073292 (0.915)
R^2	0.001	0.0004
Belgium–Luxemburg	0.2532253 (0.178)	116.2921 (0.185)
R^2	0.0578	0.0559
Germany	−0.5319501 (0.093)	−141.2675 (0.134)
R^2	0.0883	0.0709
Italy	0.2053065 (0.372)	73.79558 (0.354)
R^2	0.0258	0.0278
The Netherlands	0.6270057 (0.006)	332.1521 (0.002)
R^2	0.2175	0.2653
UK	1.808262 (0.015)	423.7076 (0.021)
R^2	0.1755	0.1776
Ireland	1.173026 (0.000)	1,502.797 (0.000)
R^2	0.5070	0.5111
Denmark	0.0817443 (0.874)	−21.40891 (0.938)
R^2	0.0008	0.0002
Finland	0.2596276 (0.613)	140.1712 (0.644)
R^2	0.0084	0.007
Sweden	−0.9427833 (0.129)	−328.9498 (0.140)
R^2	0.0729	0.069
Austria	0.3145554 (0.357)	196.7058 (0.383)
R^2	0.0274	0.0246
Spain	0.4686373 (0.001)	39.85366 (0.003)
R^2	0.3079	0.2546
Greece	0.7260571 (0.144)	1,187.044 (0.143)
R^2	0.0676	0.0681

p values in parenthesis
N=40

All the regressions were also made with PPP GDP data and considering series detrended with logs differences instead of HP filter, and the conclusions were the same. However, it is convenient to refer that, on one hand, it is still very early to definitely evaluate these relations and, on the other hand, we are considering a very long period. It would be interesting to test endogeneity with other data – eventually monthly or quarterly – in the last 10 years that correspond to the period since the signature of the Maastricht Treaty and the preparation of EMU. The difficulty is to obtain monthly or quarterly trade data. Because of these reasons, the results should be looked at with attention and interest but also with all the cautions that these questions suggest.

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